APPENDIX B: FIRE EFFECTS ON FOREST TREES

Author: Rich Fairbanks

The fire policy that guides this strategy states: "Fire exclusion is a misnomer. Low intensity and moderate intensity fire has been excluded." (USDA *et al.*, 1995). Analysis of fire scars and other data bears this out, especially with respect to the lower elevations and the southern portion of the analysis area. Both the mixed severity and low severity fire regimes identified in this strategy have extensive histories of fires that killed only a portion of the trees in a given stand. In such fire regimes, the ability of individual trees to survive a fire is a major influence on the species composition and structure of subsequent stands. Therefore a look at fire effects on individual trees is perhaps useful in understanding the fuels strategy.

Fires affect forests along a gradient of tree mortality. If fire intensity factors such as flame length, depth of flaming front and residence time are held constant, mortality is a primarily a function of:

1) Tree species
2) Tree size.

Tree species in the project area range from fire sensitive to fire resistant with a few fire dependent species.

Tree Species

The main tree species can be characterized by their response to fire. The categories of response include:

- **Invaders** Pioneer species with the ability to quickly colonize burned areas (*e.g.*, Douglas-fir).
- **Evaders** Species with long-lived seeds that are stored in soil or canopy (*e.g.*, Knobcone pine and Lodgepole pine). Some species in this group are considered to be dependent on fire for reproduction.
- **Avoiders** These species are not specifically adapted to fire and re-colonize burned areas slowly in many cases (*e.g.*, Pacific silver fir).
- **Resisters** These species survive low intensity fires through a variety of adaptations, such as thick bark, wound response mechanisms and the like (*e.g.*, Ponderosa pine, Sugar pine and Douglas-fir).
- **Endurers** Plants that resprout from underground organs are classed as endurers. Madrone, Oregon white oak and a host of shrubs fall into this category.

Tree species vary greatly in fire resistance. Table A-1 characterizes the response of upland tree species to fire.

It should be noted that some of the most common trees in the analysis area are classed as fire resisters and fire endurers. These life strategies

have enabled species to thrive in regimes where fire is relatively frequent and often of relatively low intensity. It can also be seen that many of the species classed as fire avoider are most common in the cooler, wetter parts of the analysis area, where fires are infrequent.

Table A-1. Response of Tree Species to Fire

Tree Species	Fire Resistance[1]	Fire Adaptation	Zones commonly occupied
Douglas fir	High	Resister / Invader	Coast range, Low Cascades, South Cascades, Foothills
Western hemlock	Low	Avoider	Coast range, Cascades
Western red cedar	Low	Avoider	Coast range, Cascades
Pacific silver fir	Low	Avoider	High Cascades, Cascades
Grand fir	Medium	Avoider / Resister	Foothills, South Cascades
Ponderosa pine	Very High	Resister	Foothills, South Cascades
Sugar pine	High	Resister	South Cascades
Incense cedar	High	Resister	South Cascades
Oregon White Oak	Medium	Endurer (sprouting)	Valley and Foothills
Madrone	Low	Endurer (sprouting)	South Cascades, Valley and Foothills
Western white pine	Medium	Invader	High Cascades, Cascades
Lodgepole pine	Low	Evader	High Cascades
Pacific yew	Low	Avoider	Cascades, Coast range
Chinkapin	Low	Endurer (weak sprouting)	South Cascades
Sitka spruce	Low	Avoider	Coast Range
Bigleaf maple	Low	Endurer (sprouting)	Valley and Foothills
Knobcone pine	Low	Evader	South Cascades

Tree Size

Within a given species, larger trees tend to have thicker bark. Bark is an effective insulator against the heat of a passing fire. The thicker the bark, the longer it takes the living cambium to reach lethal temperatures. This is an especially effective defense when the fire is burning in fuels with a short residence time, such as grass and forbs. This defense mechanism is less effective against fires burning in heavy fuels, such as brush and large wood.

Larger trees tend to have large crown volumes, which are high above the ground. Since most fires burn in ground fuels, trees high crowns tend to

[1]Agee, J., *Fire Ecology of Pacific Northwest Forests*. Island Press, Washington DC, 1993.

be affected by less heat from a flaming front. The total volume of crown also affects tree mortality. A tree with a large crown volume can afford to lose a considerable amount of its leaves to heat damage and still carry on sufficient photosynthesis to survive.

Fire Effects at the Stand Level

Many fires in the analysis area reach high intensities and result in complete mortality. In these situations, the ability of a tree to re-colonize an area is perhaps more important than its ability to survive the fire event. But in many cases fires burn at moderate or low intensity over portions of a stand. In these cases the ability of individual trees to survive often determines their ability to reproduce and to dominate the post fire environment. This is a common occurrence at the south end of the analysis area, where low intensity fires leave fire resister species alive while killing more sensitive species.

LITERATURE CITED

Agee, J. K. 1993a. Fire Ecology of Pacific Northwest Forests. Island Press.

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of Decision for Amendments to forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl. Washington, D.C.

USDA Forest Service and USDI Bureau of Land Management. 1995. Federal Wildland Fire Policy. (http://www.fs.fed.us/land/wdfire3.htm).

Weisberg, P. J. 1998. Fire history, fire regimes and development of forest structure in the Central Western Oregon Cascades. Dissertation, Oregon State University, Corvallis, Or.